[0067] Share. Collocated users often share information by emailing or printing out documents. We implemented two ways of sharing: slave and copy. When slaving a document, a user issues a stapling gesture to clone the source onto a blank display. In the second technique, the source is copied to a blank display using the rubbing gesture, then handed to the group member.

[0068] Open. Users can use flexible displays, or other objects, including computer peripherals such as scanners and copiers as digital stationary. Stationary pages are blank flexible displays that only display a set of application icons. Users can open a new document on the flexible display by tapping an application icon. Users may retrieve content from a scanner or email appliance by rubbing it onto said scanner or appliance. Users may also put the display or associated computing resources in a state of reduced energy use through a roll or semi-permanent fold gesture, where said condition is reversed upon unrolling or unfolding said display.

[0069] Save. A document is saved by performing the rubbing gesture on a single flexible display, typically while it is placed on a surface.

[0070] Close. Content displayed on a flexible display may be closed by transferring its contents to a desktop computer using a rubbing gesture. Content may be erased by crumbling or shaking the flexible display.

Apparatus of the Invention

[0071] In one embodiment of the invention, a real piece of flexible, curved or three-dimensional material, such as a cardboard model, piece of paper, textile or human skin may be tracked using computer vision, modeled, texture mapped and then projected back upon the object. Alternatively, the computer vision methods may simply be used to track the shape, orientation and location of a flexible display that does not require the projection component. This in effect implements a projected two-sided flexible display surface that follows the movement, shape and curves of any object in six degrees of freedom. An overview of the elements required for such embodiment of the flexible display (**1**) is provided in FIGS. **10** and **11**. In this non-limiting example, the surface is augmented with infrared (IR) reflective marker dots (**3**). FIG. **13** shows the elements of the capture and projection system, where the fingers (**6**) of the user (**7**) are tracked by affixing three or more IR marker dots to the digit. A digital projection unit (**5**) allows for projection of the image onto the scene, and a set of infrared or motion capturing cameras (**4**) allows tracking of the shape orientation and location of the sheets of paper. The following section discusses each of the above apparatus elements, illustrating their relationship to other objects in this embodiment of the system. This example does not withstand other possible embodiments of the apparatus, which include accelerometers embedded in lieu of the marker dots, and mounted on flexible displays. In such embodiment, the wireless accelerometers report acceleration of the marked positions of the material in three dimensions to a host computer so as to determine their absolute or relative location.

[0072] In one embodiment, the computer vision component uses a Vicon (**23**) tracker or equivalent computer vision system that can capture three dimensional motion data of retro-reflective markers mounted on the material. Our setup consists of **12** cameras (**4**) that surround the user's work environment, capturing three dimensional movement of all retro-reflective markers (**3**) within a workspace of 20'×10' (see FIG. **13**). The system then uses the Vicon data to reconstruct a complete three-dimensional representation that maps the shape, location and orientation of each flexible display surface in the scene.

[0073] In this embodiment, an initial process of modeling the flexible display is required before obtaining the marker data. First, a Range of Motion (ROM) trial is captured that describes typical movements of the flexible display through the environment. This data is used to reconstruct a three dimensional model that represents the flexible display. Vicon software calibrates the ROM trial to the model and uses it to understand the movements of the flexible display material during a real-time capture, effectively mapping each marker dot on the surface to a corresponding location on the model of the flexible display in memory. To obtain marker data, we modified sample code that is available as part of Vicon's Real Time Development Kit (**23**).

[0074] As said, each flexible display surface within the workspace is augmented with IR reflective markers, accelerometers and/or optic fibres that allow shape, deformation, orientation and location of said surface to be computed. In the embodiment of a paper sheet, or paper-shaped flexible display surface, the markers are affixed to form an eight point grid (see FIGS. **10** and **11**). In the embodiment where computer vision is used, a graphics engine interfaces with the Vicon server, which streams marker data to our modeling component. In the embodiment where accelerometers are used, coordinates or relative coordinates of the markers are computed from the acceleration of said markers, and provided to our modeling component. The modeling component subsequently constructs a three-dimensional model in OpenGL of each flexible display surface that is tracked by the system. The center point of the flexible display surface is determined by averaging between the markers on said surface. Bezier curve analysis of marker locations is used to construct a fluid model of the flexible display surface shape, where Bezier control points correspond with the location of markers on the display surface. Subsequent analysis of the movement of said surface is used to detect the various gestures.

[0075] Applications that provide content to the flexible displays run on an associated computer. In cases where the flexible display surface consists of a polymer flexible display capable of displaying data without projection, application windows are simply transferred and displayed on said display. In the case of a projected flexible display, application windows are first rendered off-screen into the OpenGL graphics engine. The graphics engine performs real-time screen captures, and maps a computer image to the three dimensional OpenGL model of the display surface. The digital projector then projects an inverse camera view back onto the flexible display surface. Back projecting the transformed OpenGL model automatically corrects for any skew caused by the shape of the flexible display surface, effective synchronizing the two. The graphics engine similarly models fingers and pens in the environment, posting this information to the off-screen window for processing as cursor movements. Alternatively, input from pens, fingers or other input devices can be obtained through other methods known in the art. In this non-limiting example, fingers (**6**) of the